Vol. 7. NOVEMBER, 1920 No. 9.

JOURNAL
OF THE
BOSTON SOCIETY
OF
CIVIL ENGINEERS

1848
BOSTON
SOCIETY
OF CIVIL
ENGINEERS

Published monthly, excepting July and August, by the Society,
715 Tremont Temple, Boston, Massachusetts.

Entered as second-class matter, January 15, 1914, at the Post Office at Boston, Mass., under Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 16, 1918.

Subscription Price, $4.00 a year (Ten Numbers)
50 Cents a Copy

Copyright, 1920, by the Boston Society of Civil Engineers.

BOSTON SOCIETY OF CIVIL ENGINEERS

OFFICERS, 1920-1921

PRESIDENT
FRANK A. BARBOUR

VICE-PRESIDENTS

ROBERT SPURR WESTON (Term expires March, 1921)	FRANK M. GUNBY (Term expires March, 1922)

SECRETARY AND LIBRARIAN	TREASURER
S. EVERETT TINKHAM	FRANK O. WHITNEY

DIRECTORS

STURGIS H. THORNDIKE (Term expires March, 1921)	ARTHUR S. TUTTLE (Term expires March, 1921)
JOHN E. CARTY (Term expires March, 1922)	HENRY B. WOOD (Term expires March, 1922)

PAST PRESIDENTS
(Members of the Board)

GEORGE C. WHIPPLE
CHARLES M. SPOFFORD
LEONARD METCALF

NOMINATING COMMITTEE

DAVID A. AMBROSE	WALTER W. CLIFFORD
HAROLD K. BARROWS	HARRY F. SAWTELLE
FRANK A. MARSTON	DANA M. WOOD
(Term expires March, 1921)	(Term expires March, 1922)

Past PRESIDENTS (Members of the Committee)
HARRISON P. EDDY
CHARLES R. GOW
RICHARD A. HALE

Editor — WILLIAM L. BUTCHER
715 Tremont Temple, Boston

Vol. VII NOVEMBER, 1920 No. 9

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"Dorr Systems of Sewage and Trade Waste Treatment." R. H. Eagles.

Memoir of Deceased Member.

Reprints from this publication, which is copyrighted, may be made provided full credit is given to the author and the Society.

Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETING.

Boston, October 20, 1920. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at 8 o'clock by the President, Frank A. Barbour.

There were 160 members and guests present.

The record of the last meeting was read and approved.

The Secretary reported for the Board of Government that it had elected to membership at its meeting this afternoon the following candidates in the grades named:

As a member — Mr. Erwin Harsch; and as juniors — Messrs. Harold P. Etter and George Bason Morgan.

The Secretary submitted for the committee appointed for the purpose, Messrs. Henry F. Bryant and Edward W. Howe, a memoir of John C. Olmsted, a member of the Society.

By vote the memoir was accepted and ordered printed in the JOURNAL of the Society.

After making announcements of forthcoming meetings of the Sanitary Section and of the American Association of Engineers, the President stated that the program for the evening would be a series of experience talks on Wood and Concrete Piling, and called on Past President Charles R. Gow for the first contribution. Colonel Gow responded with a most interesting and instructive talk on the art of driving piles, drawn from his large and varied experience. He was followed by Past Presidents J. W. Rollins, F. W. Hodgdon and H. F. Bryant, and by Messrs. John T. Scully and H. F. Sawtell of the Society. Mr. J. W. Taussig, of the Raymond Concrete Pile Company, and Mr. F. A. Waldron, of New York, also contributed their experiences in pile foundation work.

At 10.30 Vice-President Weston, who was in the chair, declared the meeting adjourned.

S. E. TINKHAM, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[November 15, 1920.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Goverment will not consider applications until the expiration of twenty (20) days from the date given.

Archibald, Henry Cameron, Everett, Mass. (Age 29, b. Everett, Mass.) Graduate Tufts College in 1915 with degree of B.S. in civil engineering. Entered employ of Boston & Maine Railroad, in the structural engineering department in June, 1915, and has remained continuously with that company ever since, with exception of twenty-seven months in the U. S. Army, fifteen of which were spent in France with 71st Artillery, and was regimental and battalion orientation officer in charge of the topographical work of reconnaissance. Since returning to the B. & M. R. R. has been squad leader in charge of general stress analysis of bridges and at present in charge of masonry and concrete work of the office. Refers to B. W. Guppy, Pusey Jones, A. W. Knowlton and J. B. Mailey.

Brown, William A., East Boston, Mass. (Age 28, b. East Boston.) Graduate of Mechanic Arts High School, 1910; of Lowell Institute for Industrial Foremen, 1916; and of the U. S. Navy Steam Engineering School in 1918. Draftsman with N. E. Tel. and Tel. Co., 1910–1911; with Edison Electric Illuminating Co., 1911–1913; with building department, General Electric Co., 1913; draftsman and designer in construction department, Swift & Co., 1914; on topographical survey for Stone & Webster, 1915; from Dec., 1915, to Oct., 1917, with H. S. Kimball and White, Weld & Co., as draftsman, designer on industrial and power plants; Oct., 1917, to May, 1919, Ensign U.S.N.R.F., engineering duties; June to Sept., 1919, U.S.S.B., division of operation and repairs; Sept., 1919, to April, 1920, mechanical designer with H. M. Hope Engineering Co., New Haven, Conn.; and since April, 1920, structural draftsman and designer with C. T. Main. Refers to H. S. Kimball, C. R. Main, J. F. Osborn, M. E. Pitman and F. J. Wood.

Cowles, Martin Warren, Springfield, Ill. (Age 26, b. New Haven, Conn.) Graduate Mass. Institute of Technology, 1915, with degree of S.B. in sanitary engineering. Until April, 1916, was employee of Prof. G. C. Whipple and as assistant at M. I. T. summer camp at M. I. T. water analysis laboratory. From April, 1916, to Sept., 1918, assist. sanitary engineer, Illinois State Health Dept.; Sept., 1918, to March, 1919, 2d Lieut., Sanitary Corps, U. S. A., stationed at Camp Greenleaf, Ga., and Sheridan, Ala., San. Squad 86, also on as assist. camp engineer; March, 1919, to May, 1920, analyst and assist. engineer, Illinois State Health Dept., in charge of water analysis laboratory; and from May, 1920, to date, senior assist. engineer including responsible charge of laboratory, half time field work and half laboratory supervision. Refers to J. W. Howard, Dwight Porter, G. W. Simons, G. C. Whipple and Edward Wright.

Cronin, Walter L., Boston, Mass. (Age 38, b. Boston, Mass.) Graduate of Mechanic Arts High School and Mass. Institute of Technology, 1904. Taught one year in University of Illinois; fourteen years' experience in construction and design of buildings; employed by the Commonwealth of Massachusetts as supervisor of construction for two years, and by City of Boston as building inspector, superintendent of construction and construction engineer for nearly seven years; was member of committee which revised building laws of Boston. At present with J. M. & C. J. Buckley Co., Boston. Refers to J. R. Nichols, E. F. Rockwood, H. E. Sawtell and J. R. Worcester.

Kent, Silas Stanley, Lowell, Mass. (Age 33, b. Meriden, Conn.) Graduate of Harvard College, 1910, and from Harvard School of Applied Science, 1911. Summer 1910, assistant in surveying at Harvard engineering camp; 1911–1913, engineering clerk and later assistant engineer in Hydraulic Division of Stone & Webster Eng. Corp.; 1914, with J. A. Loyster, Cazenovia, N. Y., on machine design and assembly; 1915–1917, special assistant with Mass. Commission on Waterways and Public Lands, in charge of water conservation investigation; 1917–1919, on active duty in U. S. Naval Reserve, served as commanding officer of U.S.S.C. 260, and as engineer officer and navigating officer of U.S.S. *Piqua*, 1919–20, and at present, assistant engineer with Proprietors of the Locks and Canals, Lowell, Mass. Refers to X. H. Goodnough, C. H. Pierce, A. T. Safford, G. F. Swain, W. F. Williams and D. M. Wood.

Richards, Walter Carleton, Weymouth, Mass. (Age 21, b. Weymouth, Mass.) Educated in Weymouth Public Schools and Engineering School of Northeastern College. Rodman and transitman with Whitman & Howard for sixty-four weeks; from Sept., 1919, to June, 1920, assistant with Coöperative School of Engineering, Northeastern College; July and August, 1920, with engineering department of Manhassett Manufacturing Co., Putnam, Conn.; Aug. and Sept., 1920, with George W. Perry, city engineer, Putnam, Conn.; and Sept. and Oct., 1920, with Massachusetts Dept. of Public Works, Highway Division, as rodman. At present member of Class 1921, Coöperative School of Engineering, Boston. Refers to R. H. Barnes, E. W. Branch, C. S. Ell, Channing Howard, P. C. Nash and H. C. Thomas.

EMPLOYMENT BUREAU.

The Board of Government maintains an employment bureau for the Society, to be medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and other desiring men capable of filling responsible positions.

At the Society room two lists are kept on file, one of positions available and the other of men available, giving in each case detailed information in relation thereto.

Men Available.

No. 510. Age 28. Graduate of Tufts College, 1914, B.S. in structural engineering. Six and a half years' experience on designing and detailing on structural steel and concrete, drafting and designing on submarines in U. S. Navy, and as structural steel draftsman, making and checking shop details. Desires position as structural designer or draftsman on either steel or concrete.

No. 511. Age 23. Graduate of Mechanic Arts High School and studied at Northeastern College of Civil Engineering. Seven months as transitman; one year assistant engineer and draftsman on railroad location and construction, bridge construction; one year as assistant engineer and draftsman on general surveying in and about Boston. Desires position as assistant engineer, transitman or draftsman.

No. 512. Age 29. Graduate of high school and of Northeastern College, two years University Extension courses. Three years' experience as draftsman and transitman; five years as chief of party and draftsman on construction and layout of tracks; one year as designer on mills and buildings; late experience on design of railroad structures, buildings, municipal work and as resident engineer in the field. Desires position requiring the above experience.

No. 513. Age 28. Graduate of Syracuse University, 1915, degree of C.E. Six months supervisor on concrete road construction; two and a half years as timekeeper, paymaster and cost accounting; six months equipment clerk with contractor; one and a half years as estimator and office supervision of construction; six months purchasing and expediting material; eight months on concrete drafting and designing; two months as piling inspector. Desires position with field engineers on construction, especially heavy.

LIST OF MEMBERS.

ADDITIONS.

Henderson, William D. . . . . .21 Woodward St., Boston, Mass.
Kennison, Karl R. . . . . .18 Tremont St., Boston 9, Mass.

CHANGES OF ADDRESS.

Babbitt, John H. . . . . 1847 East 86th St., Cleveland, Ohio.
Bacon, W. Herbert. . . . . 405 City Hall Annex, Boston 9, Mass.
Barry, C. Gardner . . . . .10 Blackwood St., Suite 8, Boston, Mass.
Beugler, Edwin J. . . . . .Care Foundation Co., 120 Liberty St., New York, N. Y.
Eglee, Charles H. . . . . .715 Tremont Temple, Boston 9, Mass.
Hathaway, Erwin O. . . . . .410 Hamm Bldg., St. Paul, Minn.
Hering, Rudolph. . . . . .140 West 69th St., New York, N. Y.
Horton, F. H. . . . . 452 Tyler St., Gary, Ind.

MAWNEY, R. W.	17 Park St., Room 4, Attleboro, Mass.
MOORE, RUFUS R.	93 Binney St., Boston 17, Mass.
MORSE, W. F.	916 Hippodrome Bldg., Cleveland, Ohio.
SHAW, A. L.	14 Beacon St., Boston 9, Mass.

RECENT ADDITIONS TO THE LIBRARY.

U. S. Government Reports.

Bureau of Civil Service Report. Philippine Islands. 1919.

Director of Education Report. Philippine Islands. 1919.

Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma, Marcus I. Goldman.

Topographical Maps. (41.) Department of the Interior.

Utilization of Sycamore. Bulletin 884, U. S. Dept. of Agriculture.

Water Supply Papers, 440, 451 and 474.

State Reports.

Maine. Annual Report Public Utilities Commission. 1919.

Maine. Annual Report State Department of Health. 1918.

Mass. Annual Directory of Labor Organizations. 1920.

Mass. Report State Board of Health on Sewerage of Salem and Peabody. 1896.

Mass. Report of Special Plumbing Board. 1919.

Municipal Reports.

Providence, R. I. Annual Report of Public Utilities. 1919.

Salem and Beverly, Mass. Engineers' Report on Additional Water Supply. 1910.

Salem and Beverly, Mass. Special Report on Water Supply. 1905.

Salem and Peabody, Mass. Report Special Committee on Sewerage. 1897.

Salem, Mass. Annual Report of City Officers. 1887.

St. Paul. Minn., Annual Report of Board of Public Works. 1886.

St. Paul, Minn. Annual Report Board of Water Comm'rs. 1887.

St. Louis, Mo. Annual Report of Water Comm'rs. 1919.

Somersworth, N. H. Waterworks. Contract and Specification. 1897.

Southborough, Mass. Annual Report of Committee on Water Supply. 1908.

Swampscott, Mass. Annual Report on Water Supply. 1898.

Swampscott, Mass. Annual Report of Sewerage Committee. 1901.

Swampscott, Mass. Annual Reports of Town Officers, 1902, 1903 and 1905.

Toledo, Ohio. Annual Report of Water Works. 1877.

Waltham, Mass. Annual Report of Engineering: Water, Street and Sewer Departments. 1919.

Woburn, Mass. Annual Report of City Government. 1903.

Miscellaneous.

Abrams-Harder Field Test for Organic Impurities in Sands.

Effect of Time of Mixing on Strength of Concrete. Duff A. Abrams.

Effect of Age on the Strength of Concrete. Duff A. Abrams.

Effect of Curing Conditions on Wear and Strength of Concrete. Duff A. Abrams.

Effect of Vibration, Jigging and Pressure on Fresh Concrete. Duff A. Abrams.

Design of Concrete Mixtures. Duff A. Abrams.

Modulus of Elasticity of Concrete. Stanton Walker.

Gift of Clemens Herschel as follows:

Aborigines of South America. Col. G. E. Church.

Beiträge zur Geschichte der Technik und Industrie. Conrad Matscho.

Christus Consolator. Rossiter W. Raymond.

Die Technik der Lastenforderung einst und jetzt. Kammerer–Charlottenburg.

Études sur L'Architecture Grecque. Auguste Choisy.

History of Science. An essay by Dr. George Sarton.

History of the Twenty-sixth Engineers, U.S.A. By the

Regiment, with the coöperation of New England Water Works Association.

Histoire de L'Architecture. Auguste Choisy.

Incidents in the Life of a Mining Engineer. E. T. McCarthy.

Le Sahara. Auguste Choisy.

Le Bilan d'un Siécle. 6 vols. M. Alfred Picard.

Leonardo der Techniker und Erfinder. Franz M. Feldhaus.

Leonardo da Vinci's Notebooks. Edward McCurdy.

Leonardo da Vinci. Gabriel Seailles.

Leonardo da Vinci. Richard Muther.

Leonardo da Vinci, L'Artist and Le Savant. Gabriel Seailles.

Leonardo da Vinci and His Anatomical Studies. Arnold C. Klebs.

Miracle Man, The. Frank L. Packard.

Proceedings to Acquire Water Rights to City of Rochester. 2 vols.

Principal Professional Papers of Dr. J. A. L. Waddell.

Reminiscences of an Octogenarian. Charles H. Haswell.

Repertorium der Technischer Journal-Literatur. Bruno Kerl.

Story of the Pullman Car. Joseph Husband.

Sanford Fleming, Empire Builder. Lawrence J. Burpee.

Salton Sea, The. George Kennan.

Songs and Fables. William J. M. Rankine.

Theodore Turrettini. Paul Pictet.

Vitruve. 3 vols. Auguste Choisy.

Vitruvius. Herbert Warren.

LIBRARY COMMITTEE.

Vol. VII NOVEMBER, 1920 No. 9

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

---

DORR SYSTEMS OF SEWAGE AND TRADE WASTE TREATMENT.

BY R. H. EAGLES.*

(Presented before the Sanitary Section, October 6, 1920.)

THIS paper will endeavor to point out the advantages made possible by the application of continuous sedimentation and mechanical sludge removal in connection with sewage treatment. It will describe chiefly the results which have been obtained by the use of the Dorr Continuous Thickener, which has been adapted to this field under the more pertinent name of the Dorr Sewage Clarifier, and it will suggest future possibilities. It is the hope of the writer that your Society will be interested in reviewing the history and theory of Dorr equipment and processes, in view of their recent introduction into the field of your activities.

Sedimentation is, broadly speaking, the foundation of all systems of sewage and trade waste treatment, and it also plays an important part in water purification methods. It is an essential factor in wet metallurgical operations and many chemical processes. Playing such an important part in the world's industry, it is not surprising that it should have been studied as an individual science, to determine the governing factors and to lead to some standardization.

The theory of sedimentation, on which the design and capacity of Dorr Sewage Clarifiers is based, is somewhat different from that generally accepted, and is worthy of discussion here.

---

* With the Dorr Company, 101 Park Avenue, New York, N. Y.

Generally speaking, the basic factor in causing solid particles to settle from a flowing liquid is a decrease in current velocity to secure the maximum attractive effect of gravity upon the particles. This effect would normally be expected to result from the expansion of the cross-sectional area of the flow into any shape of basin.

The assumption is doubtless the basis of the general practice of figuring sedimentation basin capacity to give arbitrary volume detention in hours. In our opinion, this basis is not entirely correct, as it assumes that the time required to fill a basin under a certain flow will be the period of detention, whereas, in actual practice, this would mean perfect distribution of flow across the entire cross-sectional area of the basin. This condition is next to impossible and difficult to even approach.

The use of " over and under " baffles in single-story settling basins has been frequently used to approach this ideal distribution of feed, but it would appear that the constriction in cross-sectional area of flow at each baffle is defeating the original purpose of the basin by increasing current velocity at those points.

We have, therefore, relied on the more positive method of expanding the *surface area of flow* to a maximum, securing uniform surface distribution by radial flow from the center of a cylindrical tank to uniform flow over a peripheral weir. This reduces the question of settling basin capacities to a matter of allowing sufficient surface (or settling area) to narrow the depth of the surface zone of flow to a minimum, so that particles will have a minimum distance to settle below the influence of the flow zone into the quiescent zone.

The basis for computation of settling areas of Dorr Sewage Clarifiers is the rate of subsidence of the solids to produce an effluent of a certain clarity.

In dilute suspensions, such as sewage or trade wastes, the volume represented by the settled sludge and its contained water is so small in comparison with the total flow of influent that for purposes of estimation it may be neglected, and the assumption that the amount of inflow is equal to the amount of effluent is on the side of safety.

On this assumption a rate of subsidence of one vertical foot per hour would represent a settling capacity of $7\frac{1}{2}$ gals. per sq. ft. of surface per hour, since there are $7\frac{1}{2}$ gals. in a cubic foot. In like manner a rate of subsidence of 2 ft. per hour would represent a capacity of 15 gals. per sq. ft. per hour, and so on. The settling area required for a flow of 100 000 gals. per hour and rate of subsidence at 2 ft. per hour would be 100 000/15=6 667 sq. ft., or a tank 94 ft. in diameter.

While the figure thus obtained is the general basis of computation, experience has shown that there are a number of factors which must be considered before final estimation, and that additional area must be allowed for according to conditions met with in each particular problem. These allowances are necessary on account of the following: (*a*) velocity of surface flow, (*b*) velocity over weir, (*c*) variations in quantity of flow, (*d*) variations in chemical and physical character of flow, (*e*) variations in temperature.

It is seen that the clarification capacity of any sedimentation tank or basin is directly dependent upon the surface area and independent of the depth except in special cases of flocculation, to be discussed later.

In other words, two tanks being fed under identical conditions, each producing an effluent of the same degree of clarity, will show a capacity in gallons per hour in direct ratio to their respective areas, i.e., one having twice the area will have twice the capacity.

It has been stated that under normal operating conditions the flow of material across the basin from feed to overflow weir takes place in a surface layer of relatively shallow depth, dependent upon varying conditions, and that the true period of detention is measured by this volume displacement which is largely independent of the depth of the basin.

It is true, however, that where periodic removal of the sludge takes place a certain depth must be allowed for sludge storage, but where continuous removal occurs, as in a Dorr clarifier, one foot in depth is theoretically as good as six feet, as far as the clarity of the effluent is concerned. In actual practice this fact is demonstrated in many successful installations of Dorr tray thickeners, handling somewhat heavier solids. With a settling tank of given volume, the original settling capacity in gallons per hour is approximately doubled by inserting a single-tray mechanism (doubling the settling area), tripled by inserting two, and so on.

Thickening of the settled sludge is an independent process, governed by entirely different principles than those of clarification. In thickening, the period of detention is the governing factor, which implies a certain volume capacity in the tank or basin for thickening; and where thickening is required depth comes in for consideration.

However, there are cases in sedimentation where the problem of thickening is not of prime importance, as, for example, the sedimentation of raw sewage. Here the chief requirement is a removal of all the solids which will settle within the limits of economical tank areas leaving an effluent containing only the finest organic solids and colloidal matter.

Under these conditions the continuous removal of settling solids in a very shallow tank, with practically a flat bottom, will suffice. Moreover, owing to the putrescible nature of the material handled, the continuous removal of such material with minimum period of detention is a most desirable condition.

While the basic factor in design of clarification units is area, there are a number of other factors which have a most important bearing on clarification efficiency.

The design of the Dorr sewage clarifier fulfills the following conditions:

1. Even distribution of flow from feed to overflow weir.
2. Maximum length of overflow weir consistent with practical design.
3. True level and alignment of overflow weir.
4. Absence of obstruction (such as baffles) which will create eddies and stray currents.
5. Protection in certain cases against formation of wind riffles.
6. Elimination of gas generation.

7. Continuous removal of settling solids in such a manner as not to create any interfering currents.

The question of overflow velocity at weir is an extremely important one. Upward currents are created which tend to lift the lighter solids and carry them over. Light solids, which have settled to a depth of 12 ins. by the time the outer limits of a tank are reached, are sometimes caught in the zone of this upward current and removed in the effluent, thereby defeating the process of sedimentation for such particles.

The depth at which these effects are noticeable is directly dependent upon the weir velocity, and by securing the maximum length of weir consistent with uniform distribution, the condition will be best cared for.

FLOCCULATION.

The requirements as to degree of clarification will generally vary with every problem. In cases where the very finest solids and colloidal matter must be removed, flocculation must be resorted to. This agglomeration of fine particles into readily settleable floccules is brought about by the introduction of certain electrolytes or coagulants, and the method is commonly known as "dosing."

In many cases the floccule formation is rapid and complete, but in others a slow rate is observed. As the floccules grow, the rate of settling increases, and the maximum rate of settling may not occur until after a period of thirty minutes or more. Under these conditions a certain period of detention is essential in order to take advantage of the maximum settling rate. This condition is obtained in a clarifier by submerging the feed well the proper distance for volume detention, with due regard to proper distribution and elimination of short circuits.

The prime function of the slowly rotating mechanism, which is the essential feature of the clarifier, is to mechanically collect all the solids which settle in a condition suitable for removal by pumping or gravity.

The design of a typical sewage clarifier is shown in Fig. 1, and an actual installation in Fig. 2. The four radial arms with

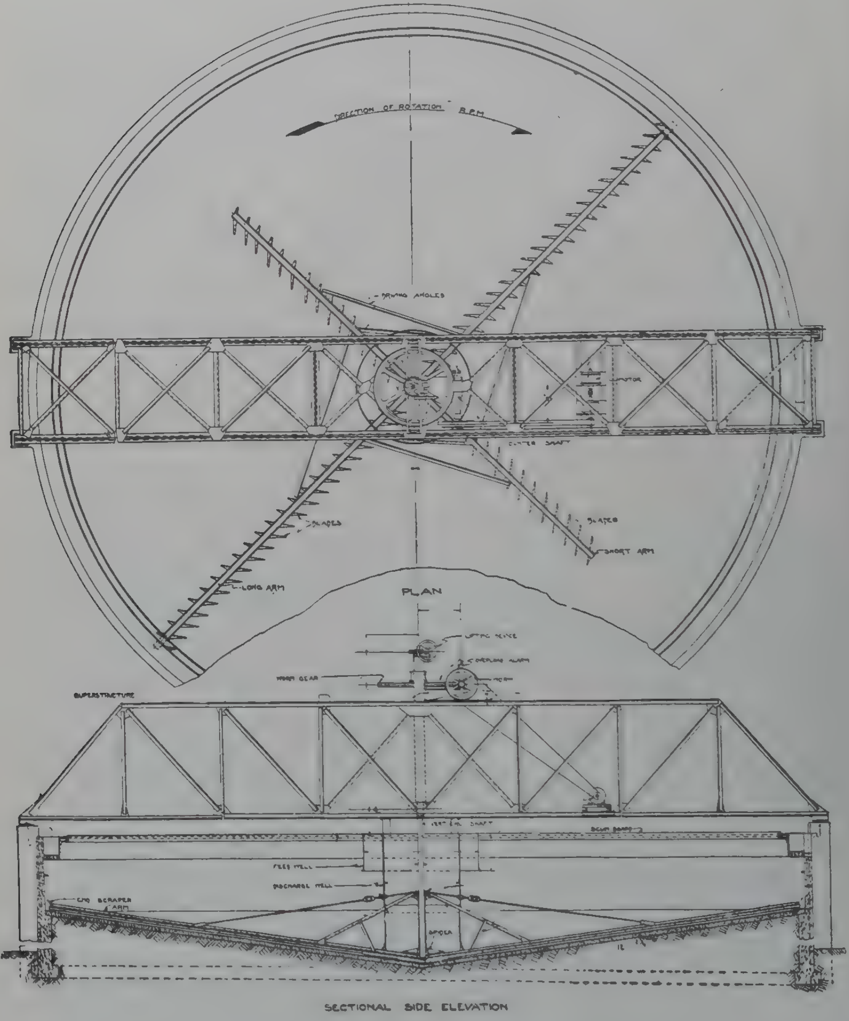


FIG. I. — THE DORR SEWAGE CLARIFIER.

plows attached slowly sweep the entire bottom of the basin, moving all solids to the center. Arriving at the center, they rise into the central sludge well, due to the piling-up action of the plows. As sludge is pumped from this well, additional sludge will flow in by gravity under the lower edge of the well.

The collected solids are piled up by the plows all around the outside of the well and form a sludge seal around its bottom opening, so that only the thickened sludge can find its way into the well when the sludge pump is operating.

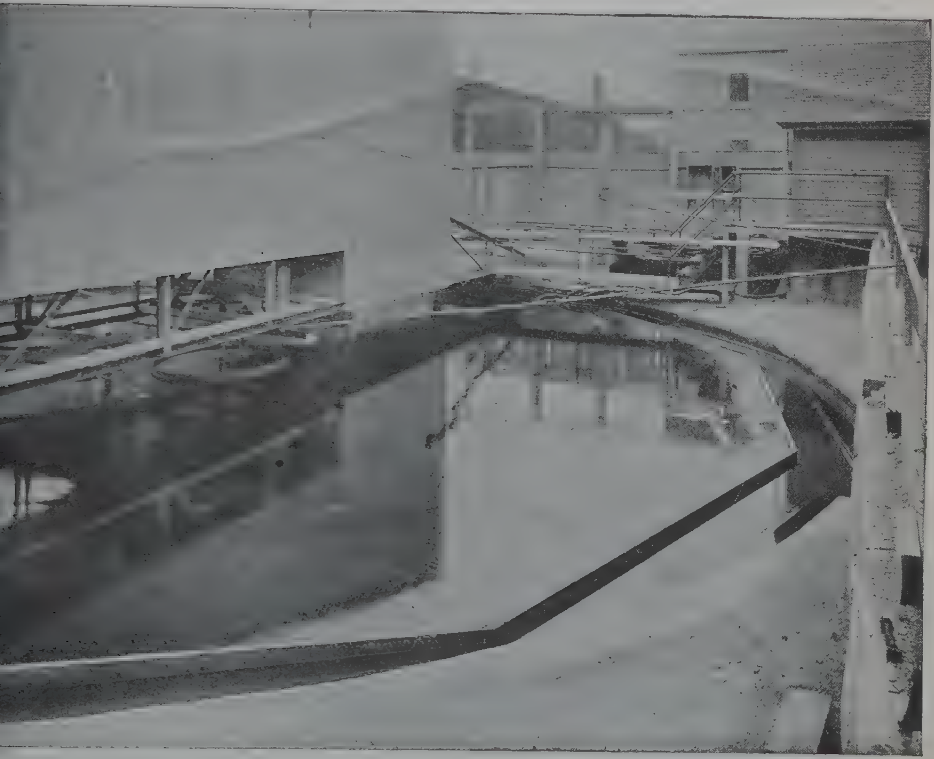


FIG. 2. — THE DORR SEWAGE CLARIFIER AS INSTALLED AT THE NATIONAL CALFSKIN COMPANY.

A thickening action takes place by reason of the compacting effect of the plows, which tend to press the sludge particles together in moving them to the center. At the same time the plows open up channels in the sludge bed, to allow the water which is squeezed out to escape.

The result is a sludge — delivered to the point of discharge in a considerably thicker condition than could be obtained by the compressing effect of gravity in a shallow basin.

At one plant a 32-ft. diameter clarifier is handling an average of 600 000 gals. daily, with a 95 per cent. removal of settleable solids and producing a sludge that has analyzed as low as 67½ per cent. moisture, and recently averaged 70 per cent. The sewage treated is domestic, combined with gas-house and straw-board-factory wastes. A cone-bottom type settling basin, with 97 degree bottom slope (Dortumud type), produced a sludge of 93½ per cent. average moisture content, operating under identical conditions. The clarifier was only one half as deep as the other tank.

The efficiency of the shallow clarifier on straight sedimentation of sewage as demonstrated by this installation indicates a favorable application to the so-called sedimentation-separate sludge digestion system of sewage treatment. It represents a considerable reduction in cost over the two-story tank system, by reducing expensive construction, with the resulting deep excavation of pumping.

At the Milwaukee testing station the sewage clarifier gave good service in de-watering activated sludge. In this case, it is essential to insure rapid and continuous sedimentation on account of the septic tendency of the aërobic sludge cultures. Difficulty has been experienced at other activated sludge plants using the slower fill and draw system. The Sanitary District of Chicago is installing seven 24-ft. sewage clarifiers at the Desplaines River experimental plant, for continuous sedimentation, as at Milwaukee.

Dorr Systems of Trade Waste Treatment.

In general, problems of this nature possess a peculiar aspect in that they entail a continual added operating expense without realization of material gain. Manufacturers are accustomed to securing a definite return on every dollar they spend, representing investment.

In most cases no definite advantage accrues from treating the waste waters, either from increased plant efficiency or from improved working conditions. The nuisance usually arises a mile or more downstream, and in many cases the offended residents are entirely unaware of the exact source of the nuisance, and consequently abatement brings no gratitude to the man who spends the money. But the ever-watchful eye of the state health authorities is guarding the public health and happiness, and it is to avoid complications from this source that treatment plants are usually installed.

Representing an added expense, an essential feature is to equip the sewage treatment plant with all possible labor-saving devices, and to insure uniform results without technical supervision. It is on this basis that the sewage clarifier has been adapted to plants of this nature, — that is, to substitute continuous sedimentation methods with mechanical sludge handling for intermittent and manual cleaning methods with the resultant higher operating cost. A number of successful installations have proven the value of the clarifier in this field.

Among the vaious types of industrial waste waters which we have studied and designed plants for are the following: Tannery waste waters, glue and gelatine waste waters, packing-house waste waters, textile mill waste waters, milk products waste waters, dyestuff waste waters, acid mine waters, metal mill pickling liquors.

A brief discussion of the general features of these wastes may be of interest.

Tannery Waste Waters.—The treatment of tannery waste waters resolves itself largely into the problem of securing a maximum beneficial effect by interaction of the various types of liquors discharged. By proper regulation of the discharge of the ionizing or precipitating tanning liquors, a considerable proportion of the offensive dissolved animal matter in the beam-house wastes will be thrown out in solid form, removable by sedimentation.

The chief reasons for the failure of the numerous home-made settling basins are: lack of sufficient capacity, lack of intelligent operation, and failure to keep them clean on account of labor costs and disposal of the large sludge volumes. An efficiently operated sedimentation unit of proper design, together with intelligent manipulation of the various wastes previous to their discharge, will produce a clarified effluent containing no appreciable amount of settleable solids, and but a small amount of suspended solids. Further purification, including removal of all color and odor, can usually be effected by sand filtration or lime dosing, according to the conditions.

Glue and Gelatine Waste Waters.—Problems of this nature have been generally handled as straight sedimentation problems for the removal of all solids which will settle. The Dorrco screen has been used in most cases preceding the clarifier. The screenings recovered are put back into the manufacturing process.

To secure an entirely clear effluent from these wastes it is necessary to break up the colloidal nature of the waters caused by the high concentration of spent milk of lime in the form of calcium bicarbonate. This effect can be obtained by the introduction of carbon dioxide to convert the bicarbonates to normal carbonates which will settle. One plant was designed on this principle, utilizing waste flue gas as a source of carbon dioxide, but it has not yet been completed.

Packing-House Wastes.—An important feature to be considered in the treatment of packing-houses wastes is the recovery of grease values. This can be accomplished by mechanical skimming operated in conjunction with the clarifier. We have not yet had occasion to design a plant for the ultimate purification of packing-house wastes, but it is suggested that activation of a well-settled effluent will produce good purification and high nitrogen recoveries in the sludge.

Textile Mill, Milk Products, Dyestuff and similar wastes, containing putrescible organic compounds in solution, in general require dosing to effect precipitation and coagulation. Lime and copperas are usually satisfactory as dosing chemicals, but we have found that the slow-settling iron hydrate flocs require relatively large sedimentation units, unless precautions are taken to secure rapid and complete flocculation. It has been found that a certain percentage of finely ground limestone mixed with the milk of lime will give weight to the hydrate flocs and cause more rapid settling. Sufficient time must be allowed in the sedimentation unit to permit the flocs to build up to their full structure. A well-clarified effluent is amenable to treatment by sand filtration at a high rate for mechanical removal of color.

Acid Mine Waters, Metal Mill Pickling Liquors, etc., are usually treated for the recovery of valuable materials. The process is neutralization with milk of lime or pulverized limestone, followed by continuous sedimentation.

DORR–PECK MODIFICATION OF THE ACTIVATED SLUDGE PROCESS.

The experimental work which led to the development of this process was undertaken with the idea of evolving an apparatus which would secure high efficiency from the air, in order to reduce the operating costs of this desirable system to a figure comparable to that of other systems in general use.

It was observed that a considerable portion of the air which was diffused into the open type of aëration chamber was inefficiently used to keep the body of sewage in agitation, the object being to produce prolonged contact between air bubbles, activated sludge flocs, and fresh sewage. It appeared as though the agitating effect of the air could be mechanically improved, as many of the bubbles escaping from the open-type aërator pursue a straight-line course from the diffusing tile to the surface, without having done appreciable work, either chemical or mechanical.

This inefficiency is shown by the fact that the normal oxygen-consuming value of the sewage-activated sludge mixture is approximately .05 cu. ft. per gal., while ordinary practice has shown an actual requirement of 1½ cu. ft., or more — thirty times theoretical. A further apparent drawback to the system is the necessity of reactivating a portion of the withdrawn sludge and returning it to the fresh sewage feed in order to continue the biologic cultivation necessary for satisfactory aërobic digestion of the impurities.

The idea was conceived that an aëration unit could be designed to effect self-contained sludge circulation and prolonged contact by utilizing the full mechanical efficiency of the escaping air bubbles in the form of an air lift.

An experimental station was established at Mount Vernon, N. Y., early in 1919, by courtesy of the city authorities, and duplicate aëration units were installed to treat a flow of 45 000 gals. per day of fresh sewage drawn from the lower side of the city bar-screen chamber, containing ¾-in. racks.

The work was directed by Mr. C. Lee Peck, director of research and development of our Sanitary Engineering Department. Mr. Peck was responsible for the inception and successful development of the experimental work.

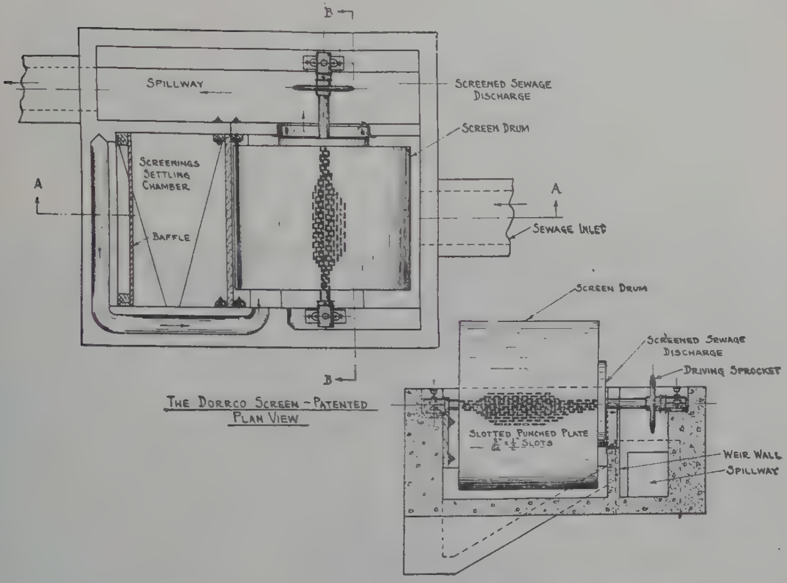
Other vital features affecting the successful aërobic treatment of sewage were developed, which have warranted the adoption of a distinct name for the modification, which has been designated the "Dorr-Peck Process."

A close study of the biologic control and stimulation has indicated the probability of high nitrogen values being recovered in the sludge, by the use of this system. It is our hope that the time is not far distant when municipal sewage may be treated at a profit.

The first unit of the experimental plant was the Dorrco screen, Figs. 3 and 4. This screen is of the rotary drum type, and has been successfully applied to the fine screening of tannery and glue factory waste waters. It is self-cleaning and economical in installation, operation and maintenance.

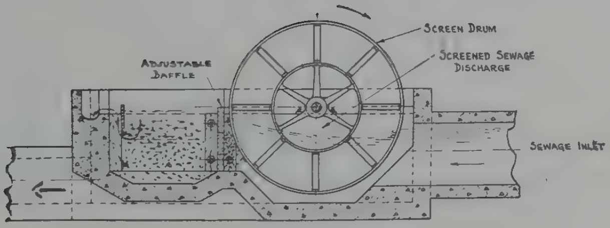
At the Mount Vernon plant a twill weave brass screen-cloth with 20 meshes to the inch and apertures .017 in. square was used as the screening medium. The screen operated without appreciable attendance, cleaning itself with thoroughness. The average removal of suspended solids over a period of thirty days was 12.2 per cent.

A slight comminuting effect in the screen action resulted in breaking up and passing through the meshes most of the soft solids, which are easily digested in the subsequent activating units. The tough and non-digestible solids were excluded, and since the latter are constituted mainly of non-nitrogeneous material, a corresponding increase in the nitrogen content of the susbequent activated sludge resulted. A further benefit resulting from this comminuting effect was a decrease in the volume of screenings to be disposed of; they are also rendered less offensive to handle.

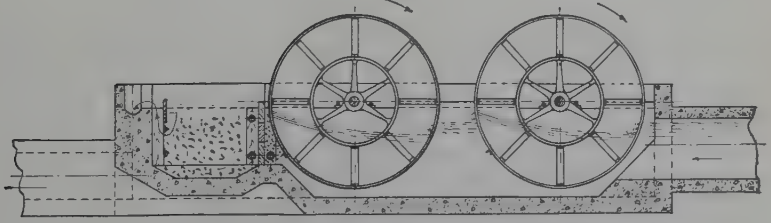

B
Spillway
Screened Sewage Discharge
Screen Drum
Screenings Settling Chamber
A
Baffle
A
Sewage Inlet
B
Screen Drum
Screened Sewage Discharge
Driving Sprocket
Slotted Punched Plate
$\frac{3}{64}$ × $\frac{1}{2}$ Slots
Weir Wall
Spillway

The Dorrco Screen – Patented
Plan View

The Dorrco Screen – Patented
Section B-B



The Dorrco Screen – Patented.
Section A-A



The Dorrco Screen – Patented
Parallel Arrangement

Fig. 3. — Dorrco Screen.

The two aëration-sedimentation units in series were designed as shown in Fig. 5. The sewage is delivered at the top of the central downcast well, and is instantly mixed with 20 times its volume of the freshly activated mixture, containing a high concentration of activated sludge solids, which are brought up from the aërating chamber and delivered at the surface from the throat of the air-lift formed by the constricted annular well surrounding the central downcast well.

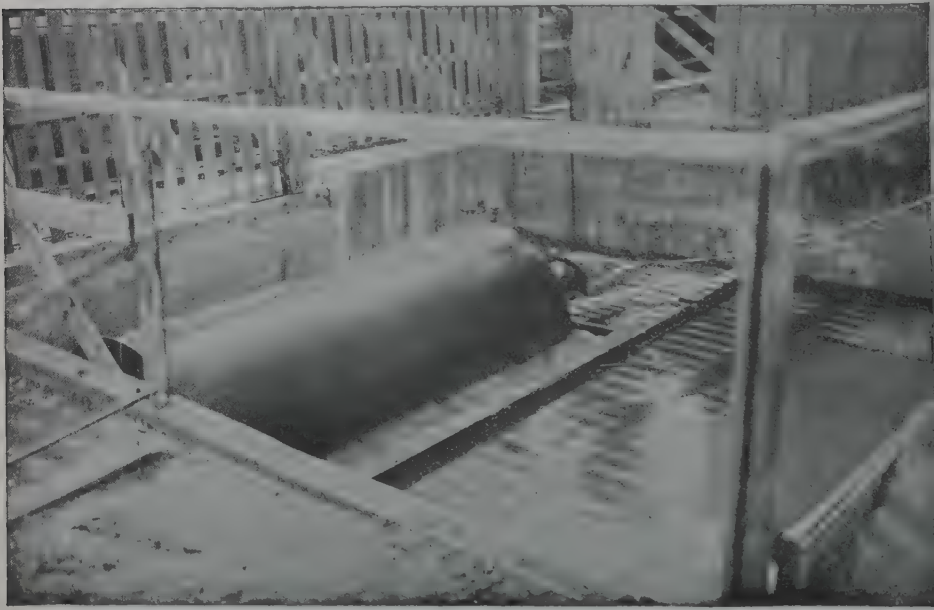


FIG. 4. — DORRCO SCREEN IN OPERATION.

The cycle is a rapid elevation of the activated mixture from the aërating chamber to the surface, receiving the small proportion of fresh sewage, and a quick passage down again by way of the central downcast well. This action tends to rapid aërobic digestion by actual dilution with the effective medium.

There is a continuous displacement from the circuit of a volume equal to the fresh feed, and this is pushed over into the outside annular well (which acts as a feed baffle and distributor); thence it flows to the quiescent sedimentation chamber in the upper portion of the tank. The liquor is overflowed peripherally from this chamber, the solids settling to the tray bottom, where they are mechanically pushed to the peripheral downcast wells, dropping through to the aëration chamber and entering the circuit again.

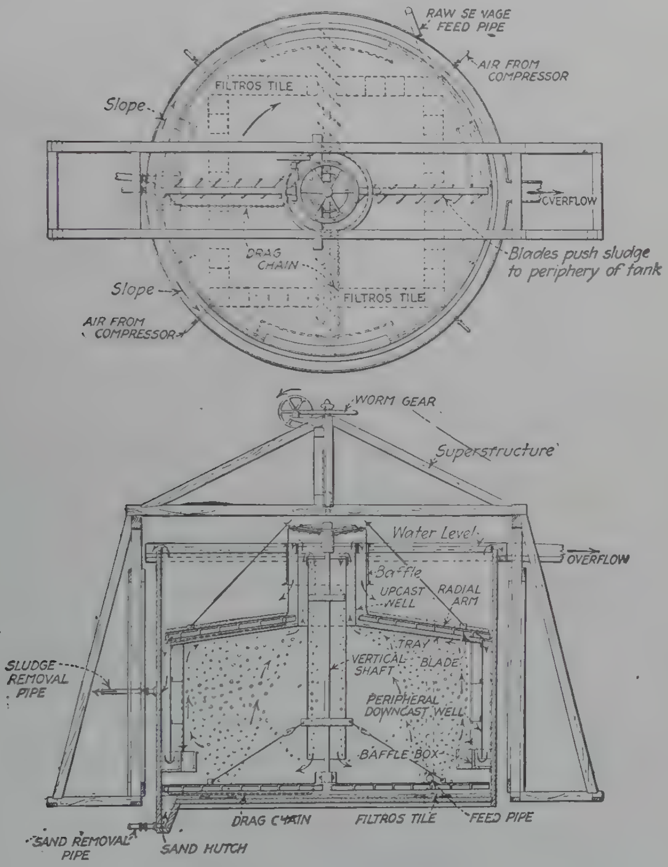


FIG. 5. — THE DORR-PECK ACTIVATED SLUDGE TANK.

A small amount of short-circuiting occurs in the displacement of feed to the sedimentation chamber, partly due to the small-size units used. That is, a small portion of the fresh sewage is pushed direct to this chamber without having passed around the circuit for proper aërobic treatment. For this reason a duplicate unit is placed in series, taking its feed from the peripheral overflow of the first unit. Here the cycle is identical except that 75 per cent. of the oxidation or activation having been effected in the first unit, a correspondingly reduced amount of air is supplied to the second unit.

In order to secure a supply of biologic sludge in the second unit to complete the purification, no sludge is withdrawn from the first unit; it is allowed to build up in the sedimentation chamber and overflow with the partly purified liquor. The only point of sludge withdrawal is from the tray bottom of the second sedimentation chamber, where it is withdrawn as required to keep it from building up and overflowing with the finally purified effluent.

The average air requirement was 0.6 cu. ft. per gal. of sewage treated, maintained uniformly over a period of two months. The detention period through the system ranged from eight to ten hours. A clear, colorless effluent was produced, containing less than 20 p.p.m. of suspended solids, up to 1 p.p.m. of nitrate and nitrite nitrogen, and was stable at least six days to the methylene blue reaction at room temperature. A 90 per cent. removal of bacteria was effected, and the oxygen-consuming power was reduced 80 per cent. The sludge contained 7 to 9 per cent. of nitrogen, on dry basis, expressed as ammonia.

The sewage treated was fresh domestic sewage of the following average composition:

Total solids, 596 parts per million.
Suspended solids, 245 parts per million.
Dissolved solids, 351 parts per million.
Alkalinity, 265 parts per million.
Oxygen consuming power, 154 parts per million.

The average flow treated was 45 000 gals. per day. The two aëration-sedimentation units consisted of cylindrical wood tanks, each 12 ft. in diameter by 11 ft. deep, combined capacity

17 600 gals. Each tank was equipped with a Dorr tray thickener mechanism, the lower arms being equipped with squeegees to move any heavy grit to a peripheral sand hutch, for removal as required. The upper set of arms swept the surface of the tray bottom of the sedimentation compartment, moving the sludge to the peripheral downcast wells for re-circulation, and preventing accumulations of septic masses. In the case of the second unit, the squeezing effect of the plows tended to de-water the sludge to ultimate density for final withdrawal. The thickest sludge removed, however, contained 98.5 per cent. moisture, due chiefly to the small size of the unit which transmitted slight disturbances, interfering with the normal de-watering operation.

The air was supplied by a Nash hydroturbine compressor, and was measured by the Rotary Meter Company's compensating meter, which is so designed as to compensate for any air pressure applied, registering only the actual amount of free air passed. The meter was frequently checked by mercury manometer readings through an orifice, and found accurate. The sewage flow through the plant was recorded over a 90 degree V-notch weir, by a Foxboro recording depth gage.

Filtros tile (Grade E) was used as a diffusing medium, with satisfactory results. No measurable building-up of pressure through clogging was registered during the five months' period of operation. Furthermore, the air supplied by the Nash compressor is quite free from dust, due to a water-washing action which is a part of its operation.

The results are gratifying, and indicate a marked advance in the treatment of sewage by aërobic methods. It is realized that they are not conclusive, by reason of the fact that the local conditions at Mount Vernon might not obtain in another locality, although the analysis indicates a strong municipal sewage.

An experimental Dorr-Peck plant on a 200 000 gal. daily basis is now in operation at Urbana, Ill., under the direction of the Illinois State Water Survey Division. This experimental work was started under the supervision of Col. Edward Bartow. The Corn Products Refining Company is also installing a small experimental unit at its Argo plant, to test its efficiency as compared with other methods. This plant will operate chiefly on the factory waste waters. The experimental work will be directed by the staff of the Sanitary District of Chicago.

DISCUSSION.

Edward Wright.* — Mr. Eagles has brought out several points that are very interesting.

I should like to ask Mr. Eagles particularly about that last statement he made of the 98 per cent. removal of settleable solids from tannery sewage. That's almost 100 per cent. pure. It seems to me a remarkable figure, particularly when producing sludge of 89 per cent. moisture. I don't think it needs qualification, but I should like to ask how long a period that test covered.

Mr. Eagles. — That was taken over a five-day period, when we tested out the plant. At times the removal will drop as low as 50 to 55 per cent. when an excessive volume of sewage comes down, or when they happen to be cleaning the beam house and discharging a high concentration of partially carbonated lime. My statement may be a trifle optimistic, in that the figure was an average over a normal period and did not consider unusual conditions. However, by definition settleable solids are those which can be removed by sedimentation, and it is therefore merely a question of capacity.

When an inquiry is received from an engineer, we give our recommendations as to type and size of units, based on our experience with similar problems. It is a matter we have tried to standardize in some industries such as tanneries, so that knowing the type of tannage, operating period and peak load we can figure fairly closely the required sedimentation capacity and also give approximate figures on the amount of solids which will be removed, the operating expense, etc. We then furnish a quotation on the complete mechanical equipment required for the installation, or such part of it as we are asked to supply.

The only guarantees we will make, under normal conditions, are as to mechanical operation of the unit, and in some cases removal of settleable solids, — where we are thoroughly familiar with the kind of material to be treated. But it is not practicable except under unusual conditions to guarantee anything other than the mechanical efficiency of the equipment.

---

* Assistant Engineer, State Department of Health, 141 State House, Boston, Mass.

With reference to the slope of $1\frac{3}{4}$ ins. to the foot in the Dorr thickener tanks, would say that it is an arbitrary figure, and we have had our casting patterns made on that basis. We have, however, designed equipment to operate with as low as $\frac{1}{2}$ in. to the foot, and get the same results. It means a difference in the time which a particle will require to pass from the periphery to the center. There are two factors entering into it, — first, flow action by reason of the slope, or gravity; and, second, mechanical action of the plows; and if it is essential to get it into the center in quick time, or if it is material like metallurgical slime that does not readily flow, then the slope is beneficial. It is our intention, however, to experiment with flat-bottom tanks, because the plows will apparently move the material equally well.

As to the advantage which the Dorr thickener has over the Pfidler spiral which was developed in England some years ago, I believe the trouble with that mechanism was that it tried to push a whole bed of sludge at once with a single spiral arm. With the short plows of the Dorr mechanism the work is done in small bits; in other words, we get the helical effect without pushing the entire sludge body. With the helical apparatus it was apparently found difficult to get a mechanism that would stand up under the strain, and the power requirements were high.

Mr. Marston has referred to a circular tank in which the wastes were discharged into the top of the tank through a portion of the periphery, flowing thence in a fan-shaped path to the circumferential weir occupying the remainder of the periphery.

In that particular installation we had a very shallow tank to start with, and were afraid with central feed we would have a pile of sludge at the center and the feed coming down would disturb the sludge pile and tend to stir it up, so we introduced the feed through one portion of the periphery and baffled it out towards the center of the basin. This gives fairly good results, but is apparently not as positive as the central feed. There is some short-circuiting.

With reference to breakage of equipment, we had some trouble at the start on account of using too light mechanisms on this type of work, particularly one case at a tannery where we first installed a small 25-ft.-diameter test clarifier. The sludge appeared to be very light and flocculent, almost like iron hydrate flocs, and apparently there would be no more strain on the mechanism than with ordinary chemical work. As a matter of fact, however, the sludge packed so dense that it put an extraordinary strain on the mechanism, and on the spider casting at the bottom, which supports the arms. This is the breaking member of the mechanism, if any — and it broke in that particular installation. We now use heavier mechanisms throughout, and also heavier superstructures to overcome any side sway. I might add that the clarifiers are equipped with an automatic overload alarm which registers the torsion on the central shaft and rings a bell in the superintendent's office to indicate that it is time to pump some sludge to relieve the load.

With certain material it is entirely feasible to use an existing square basin without closing in the corners and without sloping the bottom, because the mechanism will make its own bed; but that applies chiefly to granular substances. In the particular case you speak of, the sludge, being non-homogeneous, tended to build up in the corners, and slough off, causing a sudden excessive strain on the mechanism. We therefore closed up the corners and sloped up the bottom. The proper slope is made by spreading on a thin grout and rotating the mechanism, the plows making their own bed. The sloping bottom is particularly desirable in the case of septic sludge, otherwise there may be an accumulation which will generate gases and interfere with settling. In a number of cases we have used a cinder bottom with a tamped clay as grout.

HARRISON P. EDDY.* — I do not wish to intrude on the discussions and have the effect of shutting off questions to Mr. Eagles, but assuming that nearly all the questions have been asked it may be of interest to the members to hear a little about some of the experiences with the Dorr Company's mechanisms which have come under my observation.

---

* Of Metcalf & Eddy, 14 Beacon Street, Boston, Mass.

You may or may not be familiar with the experimental work which has been done at Milwaukee. Dating back at least as far as 1917, one of the Dorr thickeners, so-called locally at least, has been in use. Subsequently four tanks were equipped with the same kind of mechanism. If I remember correctly, two of the tanks are about 8 ft. square and the other two about 11 ft. square at the top. These tanks have been used for removing from the aërated sewage, obtained in the activated sludge process of treatment, such sludge as will readily settle. In these experiments I think I am safe in saying that the proportion of suspended matter which has been removed has averaged about 95 per cent. It has not been found practicable, under those conditions, to concentrate the sludge below 97 per cent. water or 3 per cent. solids. On the average the sludge has been somewhat less dense than that, perhaps in the neighborhood of 2½ per cent. solids. The "thickeners," however, have served a useful purpose in scraping the sludge continuously and promptly to the discharge pipes.

In other places, tanks with conical bottoms or pyramidal bottoms have been installed, and similar results have been obtained, without the use of moving machinery.

One of the problems, with which the engineering staff at Milwaukee is struggling, is how to build a series of tanks to accommodate about 85 m.g.d. and equip them with these thickeners. Obviously, if the efficiency of sedimentation — that is, the quantitative efficiency — depends upon the quantity of sewage passed through the tanks per square foot of area, the rectangular tank is the more economical other things being equal. It is also apparent that a very deep tank is not required. As a matter of fact, designs are being studied on the basis of a tank 15 ft. in depth. The problem is so to design the tank that it will be rectangular near the top and round at the bottom. The difficulty comes in the rate of slope of the sides, and still more with the rate of slope of the corners of the tank. For example, in the case of a very large tank, — one which has been studied is 75 ft. square at the top, — if the corners are drawn to a circle at a depth of 15 ft. a relatively flat, warped surface is required, in which the sludge is likely to collect and in warm weather to decompose, with unfavorable results.

Another very interesting problem is that at Syracuse, where Mr. Glenn D. Holmes, chief engineer of the Intercepting Sewer Board, proposes to install shallow, round tanks for the removal of suspended matter by sedimentation — these tanks to be equipped with the Dorr thickener. One problem has been how to dispose of the sludge. The sludge from an ordinary sedimentation tank is not a particularly easy material to dispose of, because of its peculiarly objectionable condition. At Syracuse Mr. Holmes's plan is to pump this sludge from the treatment plant a distance of several miles — two at least — to the point of discharge of the liquid wastes from the Solvay Process Company's plant. These wastes contain a very large quantity of suspended matter from manufacture of alkalies. It is present in sufficient quantity, when mixed with the sludge of the sewage of the entire city of Syracuse, to effectually bury the sewage solids when spread out in lagoons and the suspended matter is allowed to settle. The Solvay Process Company at present pumps its wastes into lagoons, allowing the relatively clear water to overflow the dikes into Onondaga Lake, the solids simply building up the land. It is a unique opportunity to be able to dispose of suspended solids from sewage by mixing them with wastes which will effectually bury them, so that they will be but a small percentage of the entire accumulation.

I was fortunate enough, through the courtesy of the Dorr Company, to have the privilege, in company with Mr. T. C. Hatton, of Milwaukee, of visiting the Mount Vernon plant, and saw the plant which Mr. Eagles has so clearly described and beautifully illustrated by his model in the other room. I was very much impressed and pleased with the operation of the screen which was there in use. There are problems with that screen, as there are with every other mechanical screen or device, but it is certainly a clever scheme by which they utilize the centrifugal force, imparted to the sewage within the screen, to wash the solids off of the screen on the outside. That is accomplished, as Mr. Eagles has explained, by raising the level of the sewage within the screen slightly above that of the sewage without the screen; and, as far as I could see at the Mount Vernon plant, the screen was being effectually cleaned. There was some doubt expressed at that time about the means of disposing of the screenings. In sewage treatment we have been trying to get away as much as possible from liquid sludge, and one of the arguments in favor of screening has generally been that solids come from the screen in a drained condition. With the Dorrco screen they are in the form of sludge, and that, I believe, will constitute one of the problems to be encountered with the use of this screen in some cases.

The aëration tank for carrying out the activated sludge treatment at Mount Vernon on the day of my visit was producing a very satisfactory effluent. The sewage was a strictly domestic sewage — one ordinarily easy to treat — and the consumption of air was low as compared with that which has been used in some other cases. Too much weight, however, should not be given to a comparison of the figures, without intimate knowledge of actual operating conditions. For instance, I suspect that .6 cu. ft. of air per gallon of Mount Vernon sewage might not be any less per unit of work done than 1½ cu. ft. per gallon of sewage such as that treated at Milwaukee. Do not take this statement as a result of comparison of analyses or conditions, however. It is simply a surmise. I mention it simply by way of caution. It isn't possible to intelligently compare estimates of the quantity of air used in the abstract without knowing a great deal about the local conditions.

I think we are very much indebted to Mr. Eagles for his kindness in coming to talk to us, and while we realize that he represents a company which is in a commercial business, nevertheless we must give to him and to the company which he represents a great deal of credit for having done some really original work in the field of sewage treatment.

ROBERT SPURR WESTON.* — The first Dorr thickener or clarifier I remember was at Colorado Springs, used for separating sludges from ore suspensions in the cyanide process. There were several sanitary engineers present, and one of them remarked that it would be well if such an efficient device could be applied to sewage. That desire has been realized.

---

* Of Weston & Sampson, 14 Beacon Street, Boston, Mass.

That the flat tank is a most efficient subsiding device is no new idea. All who are familiar with Allen Hazen's paper * will remember that he discusses the efficiency of an assumed basin in which the water passing through it flows in a thin layer while the water below it remains quiet or nearly so.

The most valuable characteristic of the Dorr clarifier, in the speaker's opinion, is its sludge-handling mechanism. This is particularly valuable in cases where industrial wastes producing large volumes of sludge are treated. In such cases this sludge accumulates so rapidly that it is often beyond the power of the management of the industry to properly care for the subsiding basins. The tank fills with sludge and becomes useless for its purpose. On the other hand, the Dorr device almost compels proper attention. The sludge is discharged continuously, and must be hauled away. The clarifiers which I have seen at Peabody are particularly successful in this particular.

I think we are very much indebted to the speaker for this excellent paper, and to the Dorr Company, which not only has produced ingenious devices applicable to the uses of sanitary engineers but is maintaining a fine research laboratory for sewage investigations, the findings of which it is using both for its own and the general benefit.

---

* "On Sedimentation." — Trans. Am. Soc. C. E., *53*, 47.

MEMOIR OF DECEASED MEMBER.

JOHN CHARLES OLMSTED.*

John Charles Olmsted was one of the leaders in the comparatively new profession of landscape architecture, and with his associates designed the greater portion of the public parks of America.

His parents were Dr. John Hull Olmsted and Mary Cleveland (Perkins) Olmsted, of Connecticut, who were traveling abroad when their son was born, September 14, 1852, in Geneva, Switzerland. His male ancestors were among the original settlers of New England, coming from James Olmsted, of Cambridge, Mass., 1632.

The young son was a delicate child with weak eyes, and his early education was largely obtained at home under governesses, and later at private school.

Dr. Olmsted died in 1857, and his widow married in 1859 her brother-in-law, Frederick Law Olmsted, who adopted his nephew and stepson as his son, although the latter developed the practice of calling him "uncle."

While a school-boy, young Olmsted spent his summers of 1869 and 1871 with the United States Geological Survey in the Rocky Mountains, on the survey of the 40th parallel and in making natural history collections.

It having been decided that he should study medicine, he was graduated Ph.B., Yale Sheffield Scientific School, 1875; but his love of nature and the association with his uncle and stepfather drew him at once into landscape architecture, of which the older man was then, as later, the leading and most successful practitioner.

The young man was always studiously inclined, and after graduation studied architecture, designing, drafting, landscape gardening, arboriculture, horticulture, etc., with some of the best men in each line, and also traveled abroad making observations and accumulating notes and photographs. He also studied in detail the many works of his stepfather and Calvert Vaux, who were associated in the design and construction of the parks of New York, Brooklyn, Buffalo and elsewhere.

---

* Memoir prepared by Henry F. Bryant and Edward W. Howe.

Young Olmsted was taken into partial partnership with his stepfather in 1878, giving the major part of his time to the designing and drafting details of the business, and became full partner in 1884. The older man broke down and retired in 1895, and the firm became known as Olmsted Brothers by including the brother, F. L. Olmsted, Jr.

Mr. John C. Olmsted's work is inextricably connected with that of the firm during his forty-two years of active participation. This work, conducted in the office on Warren Street, Brookline, was mainly concerned with public parks, towns and suburbs, and the grounds of institutions, schools and private residences, and naturally included all features of construction. It was constantly, however, a matter of design and supervision and was seldom permitted to include land surveys or building design or construction.

During this period designs were made for more than a thousand public grounds and private places throughout the country.

The work of designing and providing the great park system of Boston, and the Metropolitan Park System surrounding it, is the one in which our members knew him best, and is one that enjoyed his personal attention throughout.

It is needless to recite the names of the many works which have been designed or executed under his eye, but they include the parks of nearly or quite all the large cities which, of course, includes the grounds of our several world fairs.

Mr. Olmsted was a member of many professional and other organizations, in some of which he took a very active part, being president of the American Society of Landscape Architects for some time. He joined the Boston Society of Civil Engineers in 1887, and retained his membership until his death. While seldom seen at our meetings or on our excursions, he followed our professional papers closely and showed by his frequent comments that he was interested in and familiar with Society affairs.

Mr. Olmsted was a somewhat reticent, retiring man, of intense convictions based on the highest principles of life and art. He was broad in his religious views, independent in politics, and was forward-looking on the social questions of the day.

However much his insistence on what he considered best may have disturbed his clients, no one ever questioned his singleness of purpose or the high quality of his plans.

With a large circle of friends and acquaintances, his industry and his retiring habits prevented making many intimate friendships.

On January 18, 1899, Mr. Olmsted married Sophie Buckland White, of Brookline, and had two children, who, with his wife, survive him.

Never a robust man, he kept himself in good working form in college and in business by regular exercise and recreation. Gymnastics, bicycling, yachting, and, latterly, walking, he believed to be essential to health.

For the last few years failing health compelled a gradual withdrawal from business, and for many weary months he was confined to his bed.

Mr. Olmsted died February 24, 1920, leaving behind a record of industry and accomplishment worthy of emulation equally as an engineer an artist and a man.

ADVERTISEMENTS

Vol. VII NOVEMBER, 1920 No. 9

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

INDEX TO ADVERTISERS.

Page
A. B. See Electric Elevators, 111 Devonshire St., Boston....... vi
Aberthaw Construction Co., 27 School St., Boston............. xiv
Adams, H. S., 108 Ames Building, Boston, Mass.................. v
Aspinwall & Lincoln, 3 Hamilton Pl., Boston.................. v
Associated Architects Printing & Supply Co., 21-27 Pearl St., Boston.. xiv
Bay State Dredging and Contracting Co., 62 Condor St., East Boston.. xviii
Beattie, Roy H., 10 Purchase St., Fall River.................. xiii
Bethlehem Steel Bridge Corporation, Bethlehem, Pa......... xvi
Bishop, J. W., & Co., 683 Atlantic Ave., Boston.................. vi
Blair, Isaac, & Co., Inc., 433 Harrison Ave., Boston............. iv
Coleman Bros., 1 Marginal St., Chelsea......................... xiii
Conant Machine Co., Concord Junction, Mass................... xiii
Donoghue, P. W., 170 Purchase St., Boston xv
Eastern Bridge and Structural Co., Worcester................ xi
Fay, Spofford & Thorndike, 15 Beacon St., Boston............ v
Fort Hill Press, 176 High St., Boston......................... xiv
Fuller, George W., 170 Broadway, New York.................. v
Gow, Charles R. Co., The, 166 Devonshire St., Boston xii
Hall, John G., & Co., 114 State St., Boston.................. xiii
Holbrook, Cabot & Rollins Corpn., 6 Beacon St., Boston...... viii
Holzer, U., 25 Bromfield St., Boston.......................... ix
Hughes, Edward F., 8 Oliver St., Boston....................... xiii
Kearns Co., W. F. xix
Ledder & Probst, 21–25 Pearl St., Boston xiii
Ley & Co., Inc., Fred T., Springfield, Mass..................... iii
Main, Charles T., 201 Devonshire St., Boston.................. iv
Metcalf & Eddy, 14 Beacon St., Boston........................ v
New England Foundation Co., Inc., 70 Kilby St., Boston....... xiii
New England Sand & Gravel Co., West Peabody, Mass......... ix
Old Corner Book Store, 27 Bromfield St., Boston.............. xiii
Palmer, John E., 1012 Old South Bldg., Boston................ xiii
Penn Metal Co., 65 Franklin St., Boston....................... vi
Pennsylvania Cement Co., 161 Devonshire St., Boston.......... xii
Perrin, Seamans & Co., 57 Oliver St., Boston.................. ix

CONTRACTORS
LEY
SPRINGFIELD
MASS.

CAMP DEVENS WAS READY!

Army Cantonment at Ayer, Mass., Completed on Schedule Time

Demonstrating the Wisdom of awarding this Contract on a Cost Plus Percentage Basis

The 622 Buildings whose completion our schedule called for by September 1 were ready for the troops, and many of them occupied.

And 124 Buildings in Addition, including 46 of the 59 buildings needed for the 1,000-bed hospital unit, costing $500,000; refrigerating plants, storehouses, bakeries and miscellaneous buildings — all these completed ahead of schedule time.

Completing This $6,000,000 Contract on Schedule Time Necessitated:

- **A Force of 9,000 Men**
- **A Weekly Payroll of $400,000**
- **$750,000 in Ready Cash**
- **Finishing One Building Every Forty Minutes for Two Months**
- **The Delivery of 30 Million Feet of Lumber**
- **Unloading 50 Carloads of Materials Daily**
- **Building a Complete Water Supply System with 20 Miles of Pipe**
- **Building a Complete Sewerage System with 20 Miles of Pipe**

Capt. Canfield, in command of the Ayer Camp, informing us that Ayer headed the list of cantonments in percentage of completion, writes:

> *"This distinction should be a source of great gratification to your organization, as it is to mine."*

FRED T. LEY & CO., Inc.

Contractors

BOSTON SPRINGFIELD NEW YORK

PAGE
RAYMOND CONCRETE PILE CO., 80 Boylston St., Boston XVII
RIDEOUT, CHANDLER & JOYCE, 178 High St., Boston XIII
ROCKPORT GRANITE CO., Rockport, Mass. VII
SEELEY & LAWSON, 73 Tremont St., Boston VI
SIMPSON BROS. CORPN., 166 Devonshire St., Boston VII
SMITH, B. F., & CO., Merchants Bank Building 30 State St., Boston XIII
STONE & WEBSTER, 147 Milk St., Boston X
STUART, T., & SON CO., Newton, Mass. XVIII
THOMPSON, SANFORD E., 136 Federal St., Boston V
THORPE, LEWIS D., 201 Devonshire St., Boston V
TUCKER, EDWARD A., CO., 101 Milk St., Boston VII
TURNER CONSTRUCTION COMPANY, 178 Tremont St., Boston XV
WALDO BROTHERS AND BOND CO., 181 Congress St., Boston XI
WARREN FOUNDRY AND MACHINE CO., 11 Broadway, New York IX
WESTON & SAMPSON, 14 Beacon St., Boston V
WHITMAN & HOWARD, 220 Devonshire St., Boston V
WORCESTER, J. R., & CO., 79 Milk St., Boston V

GEO. A. BLAIR L. L. STREET W. O. WELLINGTON

ISAAC BLAIR & CO., Inc., General Contractors

Shoring and Moving Buildings a Specialty

433 Harrison Avenue, BOSTON

PROFESSIONAL CARDS

CHAS. T. MAIN

ENGINEER

201 Devonshire Street, Boston, Mass.

Rooms 817-833

Plans and Specifications for the erection and equipment or reorganization of textile mills and other industrial plants, including steam and water-power plants

H. S. ADAMS

Consulting Engineer

108-9 AMES BUILDING
BOSTON, MASS.

SANFORD E. THOMPSON
M. Am. Soc. C. E. M. Am. Soc. M. E.

Consulting Engineer

Design of Steel and Reinforced Concrete; Review of Plans; Estimates and Appraisals; Tests of Cement and Concrete; Organization of Construction and Industrial Work.

OFFICES AND LABORATORY
136 FEDERAL STREET, BOSTON

ASPINWALL & LINCOLN

Civil Engineers

3 HAMILTON PLACE
BOSTON

LEWIS D. THORPE

Civil and Sanitary Engineer

Water Works, Sewerage and Sewage Disposal
Supervision of Construction and Operation

201 Devonshire Street
BOSTON, MASS.

FAY, SPOFFORD & THORNDIKE

Consulting Engineers

BRIDGES AND OTHER STRUCTURES OF STEEL AND MASONRY. FOUNDATIONS. RIVER AND HARBOR WORKS

FREDERIC H. FAY CHARLES M. SPOFFORD
STURGIS H. THORNDIKE

15 Beacon Street, Boston, Mass.

WESTON & SAMPSON
ROBERT SPURR WESTON G. A. SAMPSON

Laboratory for the Analysis of Water, Sewage, Filtering Materials, etc., Design, Inspection and Supervision of Water Purification and Sewage Disposal Plants.

14 BEACON STREET, BOSTON, MASS.

GEORGE W. FULLER
M. Am. Soc. C. E. M. Am. Inst. Cons. E.

Consulting Hydraulic Engineer and Sanitary Expert

JAMES R. McCLINTOCK

Water Supply and Purification, Sewerage and Drainage, Disposal of Sewage and Refuse, Investigation of Epidemics, Public Utilities Valuations, Supervision of Construction and Operation.

170 Broadway, New York, N. Y.

WHITMAN & HOWARD

Civil Engineers

(Established in 1869)

220 Devonshire Street Room 504
BOSTON

J. R. Worcester E. E. Pettee G. H. Brazer
MEMBERS OF AM. SOC. C. E.

J. R. WORCESTER & CO.

Consulting and Designing Engineers

Bridges Foundations
Steel and Reinforced Concrete Construction

79 MILK STREET, BOSTON
Cement Testing Laboratory at Waltham, Mass.

METCALF & EDDY

Leonard Metcalf Harrison P. Eddy
Charles W. Sherman Almon L. Fales
Frank A. Marston

CONSULTING ENGINEERS

Water Supply and Sewerage

14 BEACON ST. BOSTON, MASS.

ROLLING STEEL SHUTTERS
COUNTERBALANCED ELEVATOR DOORS
SEELEY & LAWSON
73 TREMONT ST., BOSTON
HOLLOW METAL : DOORS AND WINDOWS : KALAMEIN
Telephone, Haymarket 3790

NEW YORK
101 Park Avenue

BOSTON
683 Atlantic Avenue

J. W. BISHOP COMPANY
GENERAL CONTRACTORS

PROVIDENCE
617 Butler Exchange

WORCESTER
109 Foster Street

More than 50 Years of Service

METAL LATH
CORNER BEAD
CONCRETE REINFORCEMENT
METAL ROOFING AND SIDING
CULVERT PIPE
BOXES, TANKS, LOCKERS
BINS, SHELVING, PARTITIONS
AND ALL FORMS OF
SHEET METAL, STAMPED,
FORMED OR WELDED

USE HAMPTON METAL
"IT WATCHES OTHERS RUST"

Penn Metal Company
65 Franklin Street
Boston, Mass.

OFFICE AND FACTORIES
BOSTON JERSEY CITY PHILADELPHIA
PORTLAND, MAINE

A. B. SEE
ELECTRIC
ELEVATORS
Established 1883

ELECTRIC ELEVATORS OF ALL TYPES

OFFICES
New York
Boston
Hartford
Jersey City
Philadelphia
Washington
Baltimore
Cleveland
Montreal
Toronto

WORKS
Jersey City
New Jersey
Montreal
Canada

BOSTON OFFICE
Minot Building
111 Devonshire St.

SIMPSON BROS. CORPORATION

TRADE MARK REG.
LAID BY SIMPSON BROS. CORPORATION
166 DEVONSHIRE ST.
BOSTON

ENGINEERS AND CONTRACTORS
FOR
REINFORCED CONCRETE
CONSTRUCTION

ROCK ASPHALT FLOORS — GRANOLITHIC FLOORS.
SIDEWALKS, CURBING, STEPS, BUTTRESSES, ETC.
SIMBROCO CONCRETE STONE BUILDING TRIM.
HASSAM CONCRETE STREET PAVEMENT.

ROCKPORT GRANITE
permanently resists all action of Sea Water

It is an undeniable fact that chemical changes take place in the cement of CONCRETE construction exposed for any number of years to sea water, changes that are certainly not for the better.

No changes take place in Rockport Granite. It is permanent, and it is impermeable; and these FACTS are beyond question. The same facts apply to masonry work of every description — Rockport Granite is the ONE material of PERMANENCY.

A combination of Quality and Low Price is offered in Rockport Granite, full details of which will be supplied upon request. Write.

ROCKPORT GRANITE CO. - RocKport, Mass.
C. HARRY ROGERS, Treas. and Gen'l Mgr.

Branch Offices
Boston, New York City, Chicago, Detroit, Cleveland and Philadelphia

EDWARD A. TUCKER COMPANY
Concrete Engineers

Designs and Estimates Submitted for Concrete Reinforcement — Monotype Deformed Bars — Spirals — Metal Forms

CONVERSE BUILDING, 101 MILK STREET, BOSTON
Direct Mill Connections **Warehouse, Cambridge** **Shop, Camden, N. J.**
Telephone, Fort Hill 1840

Holbrook, Cabot & Rollins Corp'n

Contractors

Heavy Masonry and Concrete Construction, Deep Foundations

6 BEACON STREET BOSTON, MASS.

52 Vanderbilt Avenue
New York, N. Y.

J. W. ROLLINS, President
T. B. BRYSON, Vice-President
A. P. HOOVER, Vice-President
W. S. PATTEN, Treasurer

NEW ENGLAND SAND AND GRAVEL CO.

PEABODY 244 WEST PEABODY, MASS.

SCREENED, SIZED AND WASHED

BANK SAND AND GRAVEL

ONE CAR OR A TRAINLOAD

CONCRETING, GRANOLITHIC AND ROOFING GRAVEL
BUILDING AND CONCRETE SAND

PROMPT AND RELIABLE SERVICE

WARREN FOUNDRY AND MACHINE CO.

MANUFACTURERS OF

Cast Iron Gas and Water Pipe

FLANGE PIPE *SPECIAL CASTINGS*

201 Devonshire St.,
BOSTON, MASS.

SALES OFFICES

11 Broadway,
NEW YORK

PERRIN, SEAMANS & CO.

Machinery, Tools and Supplies
FOR
Construction Work

57 OLIVER STREET, BOSTON

U. HOLZER,

BOOK-BINDER

25 Bromfield St., Boston, Mass.

ESTABLISHED 1870.

All kinds of Books bound and repaired.
Maps and Charts mounted.
Portfolios, Scrap Books, Blank Books, etc., made to order.
Lettering in Gold; Paper-Splitting; Inlaying; etc.
Photographs Mounted on Card or Paper without Cockling.

Telephone
and
Elevator

STONE & WEBSTER

Incorporated

DESIGN steam power stations, hydro-electric developments, transmission lines, city and interurban railways, gas and chemical plants, industrial plants, warehouses and buildings.

CONSTRUCT either from their own designs or from designs of other engineers or architects.

MANAGE public utility and industrial companies.

REPORT on going concerns, proposed extensions and new projects.

FINANCE industrial and public utility properties and conduct an investment banking business.

NEW YORK BOSTON CHICAGO

EASTERN BRIDGE
— AND —
STRUCTURAL CO.

Worcester, Massachusetts,
For Prices on all Classes of

STEEL AND IRON WORK.

WE DESIGN AND MANUFACTURE

ROOF TRUSSES, GIRDERS, COLUMNS, STAIRS
AND FIRE ESCAPES FOR BUILDINGS . . . .

FOOT BRIDGES, HIGHWAY BRIDGES, RAILROAD BRIDGES

We Carry a Large Stock of
I-BEAMS, PLATES AND ANGLES

Can Make Quick Deliveries. Send in Your Inquiries.

WALDO BROS. AND BOND COMPANY

Building Material and
Construction Equipment

181 CONGRESS STREET, BOSTON, MASS.

THE EXTREME HIGH QUALITY OF

PENNSYLVANIA PORTLAND CEMENT

MAKES ITS USE ESSENTIAL WHERE
WORK OF THE HIGHEST CLASS IS DESIRED

PENNSYLVANIA CEMENT CO.

NEW YORK OFFICE
30 East 42d St.

BOSTON OFFICE
161 Devonshire St.

THE CHARLES R. GOW COMPANY

Contractors for Engineering Construction

No. 166 DEVONSHIRE STREET
BOSTON, MASS.

EDWARD F. HUGHES
Artesian and Driven Wells
for
Manufacturing, Public or Private
Water Supply
954 Oliver Building, 8 Oliver Street, Boston, Mass.
TEL. 1633 MAIN

SCIENTIFIC BOOKS
AND PERIODICALS

THE OLD CORNER BOOK STORE
27-29 Bromfield Street
BOSTON, MASS.

Gravel – Sand – Crushed Stone
LOADING MACHINES
For Sale and Rent to
Contractors, Road Builders,
Sand and Gravel Dealers . .
BUILT BY
CONANT MACHINE CO.
Concord Junction, Mass.
Write, call or phone, for information, prices and circulars

JOHN G. HALL & CO.
114 STATE STREET, BOSTON
=PILING=

JOHN E. PALMER
Contracting Engineer
Contractor for Sewers, Water Works,
Concrete Bridges, Concrete
Foundations, etc.
Room 1012, Old South Building
Boston, Mass.
Telephone, Fort Hill 1731

LEDDER & PROBST, Inc.
21-25 PEARL STREET, BOSTON, MASS.
Surveying Instruments
REPAIRING
BLUE AND BLACK PRINTS
Drawing Materials

C. D. Kirkpatrick, *Mgr.* S. P. Gates, *Asst. Mgr.*
B. F. SMITH & CO., INC.
ESTABLISHED 1878
ARTESIAN AND DRIVEN WELLS
FOUNDATION BORINGS
Engineers and Contractors for Municipal and Private
Water Works
Office: MERCHANTS BANK BUILDING
30 STATE STREET, BOSTON, MASS.

RIDEOUT, CHANDLER & JOYCE
Engineers and Piping Contractors
178 HIGH STREET - BOSTON, MASS.
Steam Specialties, Engineers' Supplies
Piping of All Kinds Furnished or Erected

New England Foundation Co., Inc.
Engineering and Construction
Simplex Concrete Piles
70 KILBY STREET :: :: BOSTON, MASS.

ROY H. BEATTIE
Harbor Improvements
Divers :: Lighters
10 PURCHASE STREET
FALL RIVER, MASS.

COLEMAN BROS.
General Contractors
Main Office
1 Marginal St.,
Chelsea
Boston Address
166 Devonshire St.

Associated Architects Printing & Supply Co.

NEW LOCATION BETTER AND LARGER QUARTERS

21-27 Pearl Street, Boston

BLUE, BLACK AND VANDYKE PRINTS
GELITHO REPRODUCTIONS
SUPPLIES

Telephones, Main 8482 and 8483, Connecting All Departments

ESTABLISHED 1881

The Fort Hill Press

Our Motto
Quality and Service

SAMUEL USHER

BOOK : JOB : MAGAZINE : CATALOGUE
SCHOOL : LAW

PRINTING

DESIGNING ENGRAVING

TELEPHONE CONNECTION

176 TO 184 HIGH ST., BOSTON

Knowledge of

Engineering Design
Estimating
Planning of Operations
Purchase and Supply
Labor and its Right Guidance
Cost Accounting
Essential Control

Combined in a single homogeneous organization, adequately financed, is the

POWER behind ABERTHAW ACCOMPLISHMENT

ABERTHAW CONSTRUCTION COMPANY
BOSTON MASSACHUSETTS

ATLANTA PHILADELPHIA BUFFALO

6-94

W. B. Knowlton, Engineer AMERICAN WOOLEN COMPANY, Washington Mills, Lawrence, Mass. 264,070 sq. ft.

Turner Construction Company

New York, Buffalo 178 Tremont St., Boston, Mass. *Philadelphia, Atlanta*

P. W. DONOGHUE

Plumbing Contractor

FOR THE

$28,000,000

Boston Army Supply Base

170 Purchase Street

BOSTON, MASS.

Telephone: Fort Hill 4974

Bethlehem Steel Bridge Corporation

BETHLEHEM, PA.

Design Fabricate Erect

STEEL BRIDGES

and other Steel Structures

OFFICES:

NEW YORK, N. Y.
111 Broadway

BOSTON
141 Milk Street

PHILADELPHIA
Morris Building

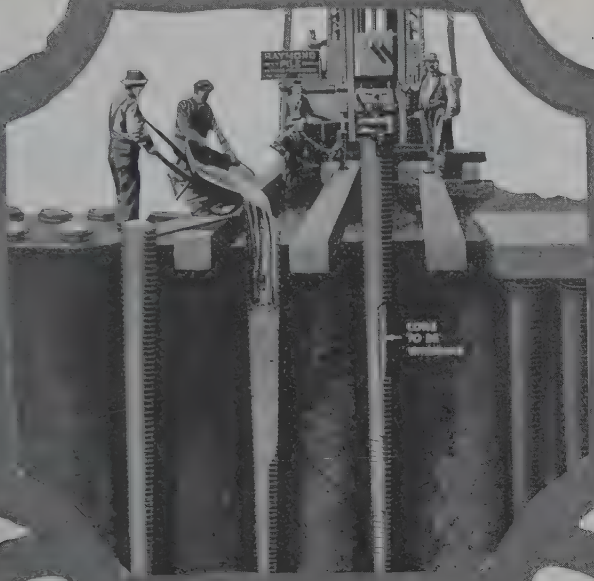
ATLANTA
Candler Building

PITTSBURGH
First Nat. Bank Bldg.

CLEVELAND
1525 Guardian Bldg.

CHICAGO
Peoples Gas Bldg.

SAN FRANCISCO
Monadnock Bldg.



THE

RAYMOND METHOD

of

Concrete Pile Installation

was chosen by the Engineers for the ARMY SUPPLY BASES at BOSTON, NEW YORK and NEW ORLEANS, because it makes absolutely certain that each and every concrete pile is perfect. A spirally reinforced steel shell is driven by a driving core, or mandrel. The core is then collapsed and withdrawn, leaving the shell in the ground. The interior of this shell may then be inspected; and finally the concrete is poured into it, the shell remaining in place to protect the pile column. ¶ We also construct Special Reinforced Concrete Work of every description: Shipbuilding, Ways, Docks, Bridges, Retaining Walls, Piers, Ore Handling Structures, etc.

RAYMOND CONCRETE PILE COMPANY

NEW YORK: 140 Cedar Street CHICAGO: 111 W. Monroe Street
MONTREAL, CANADA: Raymond Concrete Pile Co., Limited
BOSTON: 80 Boylston Street

A Form for Every Pile *A Pile for Every Purpose*

T. Stuart & Son Company

General Contractors

NEWTON, MASSACHUSETTS

Bay State Dredging & Contracting Co.

Contractors

River and Harbor Improvements, Sea Walls, Breakwaters, Heavy Masonry Construction.

62 Condor St., East Boston, Mass.

JAMES E. CASHMAN, Treas.
GORHAM H. WHITNEY, Prest. **DAVID J. WHITE, Sec'y—Gen. Mgr.**

KEARNS CONSTRUCTION COMPANY

CONSTRUCTING ENGINEERS

153 MILK STREET - - - BOSTON, MASS.

1920 promises to be the most remarkable building construction period this country has ever known.

Tremendous activity in industrial projects is already evident.

Present conditions fail to indicate any downward trend in building costs.

We suggest early consideration of anticipated operations by prospective owners.

We were the pioneers and are still the leaders in reinforced concrete construction.

We place at your disposal KEARNS SERVICE, backed by the experience of more than twenty-five years of successful building.

KEARNS SERVICE MEANS THE BEST IN INDUSTRIAL BUILDING CONSTRUCTION

SPECIAL COMMITTEES

ON THE LIBRARY

S. EVERETT TINKHAM, Chairman
HOWARD B. LUTHER
EDWARD H. ROCKWELL

ON MEMBERSHIP

SAMUEL P. WALDRON, Chairman
JOHN B. BABCOCK, 3d
JOHN E. L. MONAGHAN
FRANK B. WALKER
JOHN P. WENTWORTH

ON PUBLICATION

STURGIS H. THORNDIKE, Chairman
HAROLD K. BARROWS
HENRY B. WOOD

ON PAPERS AND PROGRAM

FRANK A. BARBOUR, Chairman, ex officio
GORDON M. FAIR
FRANK A. MARSTON
GEORGE E. RUSSELL
SANFORD E. THOMPSON
S. EVERETT TINKHAM
LEONARD C. WASON
GEORGE A. SAMPSON

ON SOCIAL ACTIVITIES

CHAS. R. BERRY, Chairman
ARMAD W. BENOIT
HARRISON P. EDDY, Jr.
WALDO F. PIKE
HOWARD C. THOMAS
RALPH W. HORNE

RATES FOR ADVERTISEMENTS

For one year — 10 issues

One page	$75.00
One-half page	40.00
One-quarter page	25.00
One-sixth page	17.50
One-eighth page	14.00
One-twelfth page	10.00

Last page, 50 per cent. additional.

For further information, or for contract forms, address

WILLIAM L. BUTCHER, Editor
715 Tremont Temple, Boston

SAMUEL USHER
BOSTON